VOL. 3 NO. 4 April 1986

COMPUTER DIGEST

A NEW KIND OF MAGAZINE FOR ELECTRONICS PROFESSIONALS

PACKET RADIO
What Cellular Did For The Telephone...

A GERNSBACK PUBLICATION

COMPUTER CARE
Preventive Maintenance Extends Computer Life

GRAFEX-32
Part 3, The Conclusion

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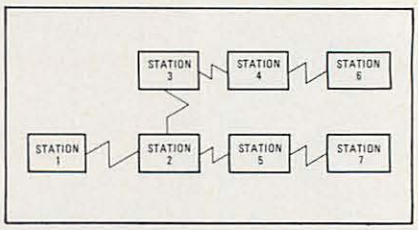

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ON THE COVER

Sitting atop that beautiful Heath computer terminal, is their brand-new HD-4040 Packet Radio Adapter. For more detailed information, turn to page 10.

COMING NEXT MONTH

We're going to show you how to use a TI-99/4A keyboard with your Sinclair ZX-81, and we'll have an excellent program that lets you use your computer to select power supply components. To round things off, look for an article on power control with your Commodore-64 that lets you "automate" your home!

EDITORIAL

Wonderful idea #1275

■I've had another wonderful idea that I want to share with you, in the hope that it will be brought to the attention of some of the manufacturers in the computer business. I'm in the process of setting up a new computer system. It isn't an especially large or complex system, and should ordinarily pose no problems.

But this computer comes with—not one, but *two* large loose-leaf tomes. In order to get up-and-running, you've got to read both of these books which seem to have been written by engineers. Now engineers, as we all know, write to *impress*, not to *express*. The writing is confused and convoluted, hard to follow, full of digressions and fishbacks, and the books are laden with charts and diagrams, rife with "If..." "However..." "Refer to..."

The result is total frustration, utter confusion and complete disgust.

Oh, you can fight your way through the books if you have sufficient patience and a friend who knows a little more than you do. But Wonderful idea #1275 is going to solve the problem once and for all.

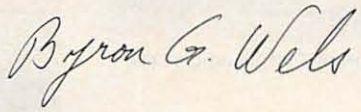
Each manufacturer should hire a *writer* to write his instruction books. I realize that this is an unheard-of concept, and one that no manufacturer thinks is viable. After all, a writer is liable to make *sense* out of the instructions. With an easy-to-understand book, the user might even wind up knowing what in heck he's doing. Surely, we wouldn't want *that* to happen!

Of course, this might lead to fewer service calls, saving the manufacturer a lot of money, but that is not important in the overall scheme of things. Then too, the engineers who now write these semi-literate instructions might get their noses out of joint.

So what is really needed, is an *additional* instruction book which will serve to translate the existing instruction books into more-readable (and understandable) prose.

Now take the books I'm currently fighting my way through. One volume deals with the hardware, the other with operating instructions. You can get just so far with the operations, when you learn that you've got a DIP switch set incorrectly. To *locate* that switch, you've got to put this manual down and pick up the *other*. The instructions for setting that switch are no easier to understand than the rest of the manual, with diagrams that just don't help. Now I'm not stupid. And I'm supposed to be computer-literate. But I keep thinking of the poor boob that has less knowledge than I do, and wonder how he's going to make out!

C'mon Wonderful idea #1275!



Byron G. Wels
Editor

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Gernsback Publications, Inc.
500-B Bi-County Blvd.,
Farmingdale, NY 11735
516-293-3000
President: Larry Steckler
Vice President: Cathy Steckler

ADVERTISING SALES 516-293-3000
Larry Steckler
Publisher

NATIONAL SALES
Joe Shere
1507 Bonnie Doone Terrace
Corona Del Mar, CA 92625
714-760-8967

LETTERS

Help!

I'd be happy to pay any costs for a service or theory manual for the Timex-Sinclair ZX81. I'm a beginner in the electronics field and any help would be appreciated. Write to Juan Bonilla, 42 Baldorioty St., Sabena Grande, PR 00747.

We don't usually print addresses Juan, but this seemed to be the best and fastest way to get aid to you.

Penance!

Yours is the only large-circulation magazine that has ever carried serious coverage of the Timex/Sinclair 1000. In a recent issue you told a reader that support for this wonderful machine had died. Tain't true! There are a lot of firms providing support to these units, and a lot of people still using them. Thanks for the best electronics magazine around. Keep up the (almost always) good work!—B. C. T., Tucson, AZ.

Thank you sir. Humble pie can be delicious. We got lots of letters just like yours, so here's what we're going to do: Any firms out there that provide service, parts, literature, software, whatever for the TS/1000 and ZX-81, please write to the Editor. We'll compile a complete listing (on our own time, boss) and make the list available to all our readers at no charge. Are we friends again?

Noisy Printer

How can I reduce the noise level from my printer? It's working properly, but it does seem awfully loud.—S. K., Abilene, TX.

Start by placing a sound-absorbing pad under it. Often, the surface on which a printer is placed acts like a reverberator and amplifies the sound. If that doesn't help sufficiently, try using a soundproof housing over the printer for air-transmitted noise.

Computer Chess?

Has anybody worked out a program that will enable me to play chess using a computer and a modem? I'm certain that a lot of people who are involved in both chess and computers would be interested.—R. C., Denver, CO.

Sounds fascinating. Can anybody help?

New Software

I've developed an interesting new software package that just about every computer user will want. What's the best way to market such a product?—L. W.. St. Louis, MO.

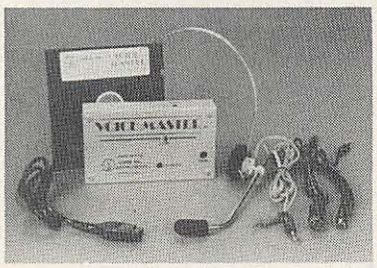
Begin by writing to our advertising sales department who will be happy to send you a media file and rate card!

COMPUTER PRODUCTS

For more details use the free information card inside the back cover

SPEECH SYNTHESIZER, the *Voice Master,* a hardware/softwear system for mircocomputers that provides speech and music synthesis as well as voice-recognition capabilities, can use almost any spoken language for its operation. Unlike other speech devices for microcomputers, the *Voice Master* does not depend on a speech chip to create its vocabulary. The user digitally records his or her own voice to provide the vocabularies of up to 64 words or phrases for the unit. Those recorded vocabularies are then played back to reproduce the words or phrases as directed by the user in high-quality sound that closely resembles a tape recording of the user's voice and can record in any language.

The *Voice Master* is also capable of highly-accurate *voice recognition* and can recognize and store vocabularies of up to 32 words or phrases each on floppy disk. Vocabularies for both

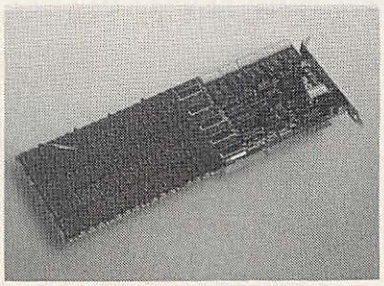


CIRCLE 11 ON FREE INFORMATION CARD

speech and recognition may be instantly called and loaded from disk.

The *Voice Master* is available in models for the Commodore *64/128,* Apple *II* series, and Atari computers for a suggested retail price of $89.95, which includes the *Voice Master* module, program disk, headset/microphone, connecting cables, and a comprehensive documentation booklet.—**Covox, Inc.,** 675-D Conger Street, Eugene, OR 97402.

ADD-ON MEMORY BOARD, the *Cheetah Card™,* is designed for the IBM PC-AT and compatibles. It not only adds 2.5 megabytes of memory per card, but also allows the AT to run



CIRCLE 17 ON FREE INFORMATION CARD

up to 30% faster with its *no-wait* state.

The *Cheetah Card™* comes with a full 3-year limited warranty and is priced at $945.00.—**Cheetah International, Inc.,** 107 Community Boulevard, Suite 5, Longview, TX 75606.

SOFTWARE REVIEW

Best Friend...$84.95.

■When our company switched over from a CP/M system to MS-DOS, the *last thing* anybody wanted was to have to put down the instruction manuals and do a software review. After offering the package around to several of my co-workers, I found it back on my desk.

Let me tell you something. I'm glad it worked out like that. Best Friend, as the program is called, is precisely that and is worth all of the gibberish instruction manuals that ever came with *any* computer. I casually glanced through the brochure, flipped through the book, and then inserted the disk in my A: drive. Typed in A: and return, then (as the book told me to, I typed "BF" and enter. A menu appeared.

Using the function keys, you select any of the ten items on the menu or ESC to go back to your regular applications. Arbitrarily, we selected the calculator function and pressed that. The screen informed us that it was "being loaded," and then the calculator appeared. Knocked our socks off. This isn't a calculator any more than a Rolls Royce can be described simply as a "car." It's a full-function scientific *printing* calculator that will do anything you can expect any calculator to do.

The system provides six basic functions: File Services (copying, deleting, and renaming files), Disk Services (formatting, copying and comparing disks), I/O options (lets you specify printers to ports and set serial port parameters), Typewriter Emulation (gives you the equivalent of a full-featured electronic typewriter), Scientific/Business Calculator (many easy to use functions including "tape," printer control, ability to return results to a program), and finally, Output Redirection (gets reports on disk that until now could only be output to the printer). And Best Friend can be run as a "stay resident" program so all its features can "pop-up" behind whatever else you are doing!

Suddenly, the sub-title on the instruction book, "Makes PC-DOS easy to use" had new meaning. We started playing with the other available files. I want to tell you something: I could sit here and fill up space talking about the different available functions, about how well thought-out this program is, and how it's probably the best thing to come down the pike since sliced bread. But you didn't just fall off the turnip truck either. Best Friend is available in a demo package for a mere $14.95 or the full package for $84.95. Since they have tailored systems to exactly suit the computer you have (Yes, even CP/M) it would be a good idea to send for their descriptive brochure first which contains an ordering coupon. There's no charge for that brochcure.

Of equal importance in this day and age, is the fact that it is *not* copy protected.

The bottom line is that Best Friend has and continues to perform a valuable service here. It has made our new computer easier for me to use, thereby making me a more-valuable asset to my company. It has eased the transition into the new computer as well. But the fact is that even if I were an old hand at the new computer, I'd still value Best Friend, for it has been able to show me some features I didn't know existed. To order or send for a brochure (you should!) write to Elite Software, P. O. Drawer 1194, Bryan, TX 77806. If you're out that way, you can telephone. (409) 846-2340.◀Φ▶

COMPUTER CARE

It doesn't take much, and it pays off.

HERB FRIEDMAN

■The way it appears in the mail order catalogs of data processing supplies, at least 26 hours of each workday should be spent cleaning, checking or adjusting your personal computer. In fact, we are fast approaching the point when the different kinds of "computer care" products will outnumber the the books on personal computing.

The desktop personal computer and its peripherals are among the most reliable of consumer products, requiring a minimum of attention to keep them going. A quick pass with a brush now and then, a wipe with a cleaning pad, a check of frequently moved cables and connectors is all that's needed to insure years of trouble-free operation, assuming a "chip" doesn't break down. While a failure at the "chip level" generally is catastrophic, short of using common sense when you initially install and service the computer there is little you can do to avoid it.

Fresh air first

Assuming the power supply doesn't blow up and take a handful of components with it, it is primarily heat that destroys chip-level components, so the first step in computer care is to install the equipment in such a way that there is an air flow through the enclosure(s). Even when a computer (or a peripheral) is equipped with a cooling fan or blower it is assumed there will be a known minimum rate of air exchange within the enclosure when the device is located on top of a table. Hiding the computer from view inside a cabinet or a desk restricts air flow, sharply elevating the operating temperature in the cabinet. Even if you employ an accessory fan or blower fan for a computer installed within a decorative cabinet it usually ends up recycling warm air (which gets even warmer) (Fig. 1).

An auxiliary fan is rarely required for computers as initially supplied by the manufacturer. But if you load the computer with several internal accessories the build-up of ambient heat can easily exceed the original design limits, and a cooling fan might be required to avoid shortening the life of the internal components, and reduce or eliminate intermittent glitches caused by heat overload. (It is not uncommon for socketed integrated circuits to develop intermittent contacts after a few years of cooking in the heat. The problem is usually due to the heat-sensitive metals used for contacts in cheap sockets.) Both the Apple and Radio Shack Color Computers are good illustrations of how accessory hardware raises internal ambient heat above safe limits. As initially equipped by the manufacturer neither computer needs a fan when located on a table, but both are known to "glitch out" when loaded with accessories if the "extra" heat isn't vented by an accessory fan.

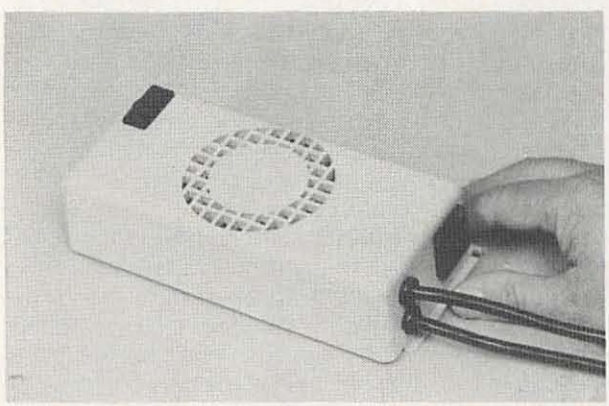


FIG. 1—IF YOU HAVE LOADED your computer with internal accessories beyond what the manufacturer originally supplied, or age is causing intermittent glitches after hours of operation, an accessory fan might be the cure for heat-caused gliches. A fan such as this for the Osborne computer is enclosed in a housing that either slides into place or is easily secured with sticky-tape or a few screws.

FIG. 2—AN UNSHARP, FUZZY SCREEN display is usually the result of dust on the face of the CRT rather than an electrical breakdown. You can save an expensive "overhaul" service charge if you simply clean the CRT with a common household glass cleaner. (Special CRT cleaning products don't justify their extra cost.)

Except for esthetic reasons, dust covers are rarely needed for modern personal computers. They might be needed to keep coffee and paper clips from falling into a printer, but that's about it. The modern keyboard uses sealed keyswitches so dust can't affect the keys, and no commonly-used personal computer puts a foam filter in front of a fan to catch dust, and thereby restrict the air flow as the filter gets clogged (one of life's dumber ideas). In fact, most internal computer fans and blowers simply pass the dust inside the cabinet where it settles out on the components—and causes no problems.

Dust creates problems only when it settles on the CRT or a disk, or gets picked up on a disk when the disk falls on the floor, or it takes the form of oxide flake-off from magnetic media and collects on the read/write head of a cassette recorder or a disk drive.

Dust on a CRT is insidious because it destroys the sharpness of the image: it's the reason why many terminal operators start to complain about tired eyes or blurred vision. The static charge on the face of a CRT attracts dust, and within days a relatively thick film can build across the face of the CRT. The dust in turn diffuses the screen display, causing the image to bloom. The heavier the film of dust the greater the bloom, and, therefore, the fuzzier the image. Blooming produces the same kind of tired eyes as looking through eyeglasses having the wrong prescription. As a general rule, the problem is avoided by cleaning the CRT every few days with a window cleaner such as Windex. (Fig. 2) Dust that settles out on a disk, or which adheres to a disk when the disk falls to the floor, is a problem not because it can ruin the mechanism, but because a "solid particle" can scratch the disk itself and destroy data bits. The way to get rid of the dust is to blow it off with either air or a neutral gas. While there are several pressurized products in the marketplace, some employ freon, which is a refrigerant. It not only chills the disk, possibly deforming the substrate (the disk itself), the change in temperature can cause moisture on the disk. The safest products are those used by photographers to clean negatives because they usually come out at room temperature. Two such products are OMIT, which is a neutral "gas," and Falcon, which is filtered air. Neither will chill a disk nor cause moisture. (Fig. 3)

The only dust that normally causes a problem in computers is the oxide flake-off from magnetic media: cassette tape and disks. Much of the low cost cassette tape is cheaply made and has excessive flake-off, which can cause an oxide build-up on the head that actually lifts the tape off the head. While "tape lift" generally interferes primarily with *reads*, if the lift is severe it can drop bits on a *write*.

There are many "head cleaning" chemicals which, as far as we know consist of denatured alcohol and some "magic" additive. The best head cleaner is a cotton Q-tip dipped in ordinary denatured alcohol. If you want to clean the entire tape path—which includes the tape guides and the capstan pinch roller—use a "cleaning cassette," a conventional cassette having a mildly abrasive cloth tape instead of magnetic recording tape.

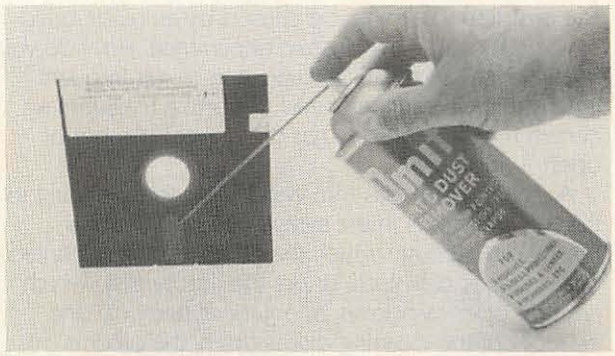


FIG. 3—IF YOU DROP A DISK on the floor, or dust has settled out, don't try to blow it away with your breath or a Freon-based aerosol product—either way you can cause moisture on the disk itself. Instead, blow the dust away with one of the "neutral" products photographers use to blow the dust off negatives.

You squirt a few drops of head cleaning fluid on the cloth tape and run the machine for a few seconds. The fluid loosens the accumulated oxide crud and the cleaning tape lifts it off and traps the particles. (The saturated cloth beats just about anything, no matter how expensive, when it comes to cleaning a cassette recorder.)

Disk drive read/write heads are something else. Regardless how it's packaged, the actual cleaning device comes down to a mildly abrasive disc (usually fiberglass) packaged in a sleeve that closely resembles a conventional disk. (Fig. 4) Generally, a cleaning chemical is squirted on the disk to loosen whatever has supposedly accumulated on the head(s). Running the drive causes the cleaning disk to scrub the head(s) clean. Since a cleaning disk is abrasive (otherwise it wouldn't clean the head), there is considerable debate whether the cleaning disk can do more damage than it cures. (The service department of at least one major disk drive manufacturer will tell you not to clean the head at any time.) In fact, it's questionable whether disk drives ever need cleaning because data disks do not usually shed excessive oxide; if there should be some flake-off it is usually trapped in the microscopic pockets of the liner inside the disk sleeve: That's why the liner is there in the first place. Cleaning of disk drive heads should only be done when you are certain there

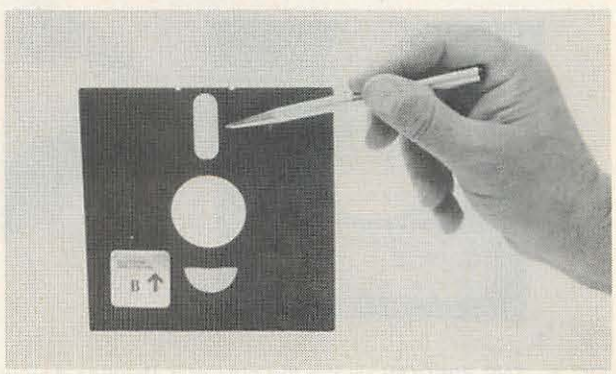


FIG. 4—A CLEANING DISK contains a mildly abrasive pad that contacts a disk drive's read/write head through a window in the sleeve. The pad is usually soaked with a "cleaning fluid."

is a problem that might be caused by an oxide build-up on the head—a really rare occurrence. How do you know when it happens? Iif you start to get frequent read errors cleaning the head is worth a try. But make certain the cleaning disk has the correct number of open "windows."

A cleaning disk has two windows corresponding to the two windows in the sleeve of a conventional floppy disk through which the read/write head contacts the magnetic disk itself. Unlike the floppy disk, which has two open windows, as a general rule only one window of the cleaning disk is open, the other is covered by a peel-off tab. If you have dual-sided drives you peel off the tab so both heads get cleaned. If you have a single-sided drive you must leave the tape in place, else you end up scrubbing the small pressure pad that squeezes the disk against the read/write head, and this can cause trouble because it allows the cleaning disk to grind grime and dust into the pad; and the dust ground into the pad can cause the pad to drag and possibly slow the disk speed outside the normal tolerance range. (Fig. 5)

Don't clean the heads for too long. Entering DIR (for directory) will cause the drive to work for a few seconds, and that's all the cleaning that's needed. If that doesn't correct the *read* problem the trouble is probably in the hardware, and the most common problem is incorrect drive speed, which is usually checked with an "analyzer" disk that tells you the actual disk speed in rpm. If you don't have an analyzer disk you can check the speed by aiming a neon or flourescent lamp at the small strobe pattern on the disk drive's motor. If the pattern doesn't appear rock steady the speed is off. Adjust the disk drive's motor speed trimmer screw until the pattern "freezes." If the pattern is steady and you still get *read* errors it's time for an overhaul by a shop specializing in disk drives. (Fig. 6)

If a drive drops out suddenly, if you get messages such as "I/O ERROR," or "DRIVE NOT AVAILABLE," check the small drive select programming plug; it might have come loose or fallen out. Possibly, vibration worked it loose. (This is not an uncommon problem when an independent dealer starts pinching pennies.Some of

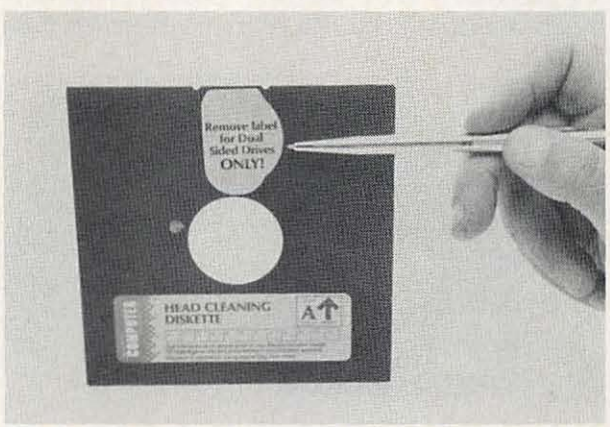


FIG. 5—THE WINDOW on the flip side of a cleaning disk is usually covered by a label. The label must not be removed if the drive is single-sided (one head). If the drive is double-sided (two heads) the label must be removed so both heads are cleaned at the same time.

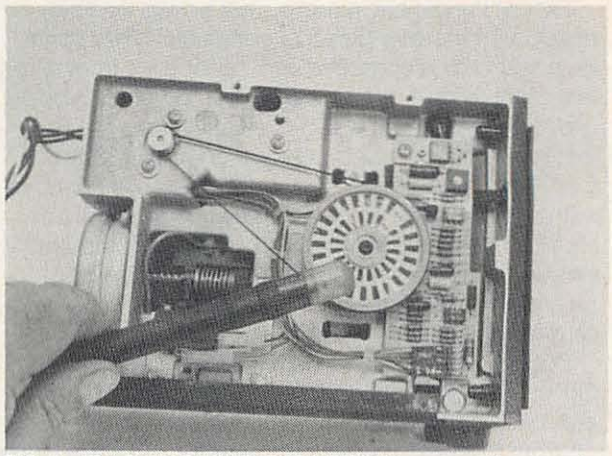


FIG. 6—IF A DISK DRIVE PRODUCES I/O errors after cleaning check its speed by holding a small neon or flourescent test lamp near the strobe pattern "painted" on the drive's flywheel. If the speed is on-the-mark the strobe pattern will freeze. If the pattern's "bars" drift adjust the drive's speed control until the pattern freezes.

the dealers who put together their own "IBM computers" from conventional parts save .001 cent by using anything other than the proper programming plug. In the illustration shown, the jumper was one section cut from a conventional 4-section plug.) (Fig. 7.)

Many intermittent computer problems can be traced to card edge "fingers" and their connectors which aren't gold plated. Many card edge fingers are simply tinned with lead and they eventually develop an insulating oxide. All that's usually needed to get rid of the oxide is to simply remove and reapply the connector, whose contacts wipe the oxide from the card edge fingers. Unfortunately, the cheap sockets usually used for the unplated fingers aren't all that good either, and over a period of time will lose sufficient tension to clean the fingers. If just removing and restoring the connector doesn't provide a reliable contact wipe the oxide off the fingers with a "game cartridge"cleaning stick: A small stick with a mildly abrasive plastic pad at one end that is saturated with alcohol. The cleaning stick was originally intended for

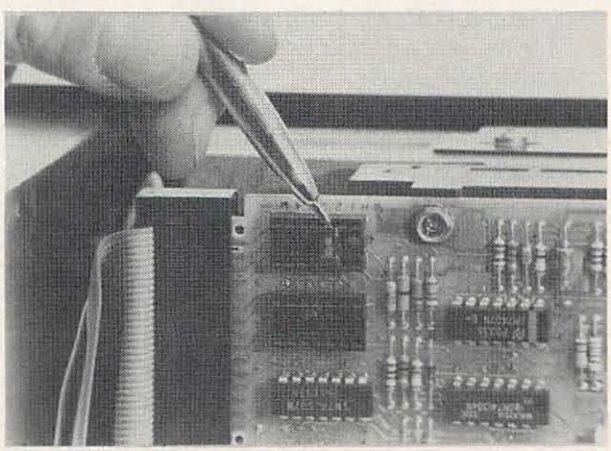


FIG. 7—SOME DISTRIBUTORS save a penny or two by shipping an "IBM type"drive with a "drive select jumper" cut from a larger DIP shunt. It's been known to work loose, so check that it's seated if the computer doesn't recognize a drive exists.

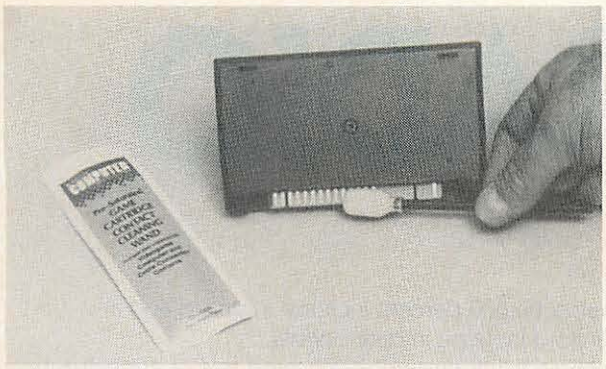


FIG. 8—SOME COMPUTERS and peripherals don't use gold plated edge connectors. If the fingers are simply tinned with solder or even tin plated they can develop intermittent contacts. If you suspect the fingers, just scrub them clean with the same kind of cleaning wand or stick used to clean game cartridges (game cartridges use similar edge connector).

cleaning the contacts on game cartridges, many of which use the same cheap construction as "leaded" computer card edge connections. The stick usually works even better than scrubbing the contacts with a pencil eraser. (Fig. 8)

Use the same procedure with intermittent cassette recorder connections. Usually, the recorder goes untouched for months, and plugs and jacks can develop the same kind of insulating oxide as finger contacts. As a general rule, moving a plug in and out of its jack a few times will wipe the oxide free. If it doesn't, dip the plug in alcohol and run it in and out of the jack a few times—that will usually get rid of the most stubborn dirt. (Fig. 9) If you still have an intermittent connection when you wiggle the plug it's more than likely the jack's "tip" connection has lost its tension (it happens to cheap jacks after a few years), which means the jack itself will have to be replaced because even if you bend the tip connection it will simply deform the next time the plug is inserted: You cannot restore tension to the cheap jacks used on cassette recorders. (Fig. 10)

The modern desktop printer can run for years with

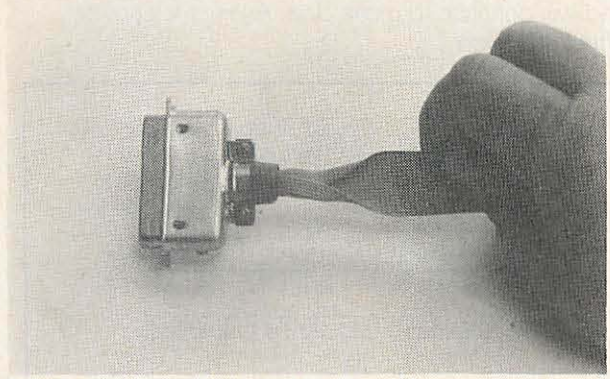


FIG. 9—FREQUENT REMOVAL of large insulation-displacement connectors, such as those used for Centronics-type printer connections, often cause the wire to pull loose inside the connector. If your cable develops intermittent connections replace the insulation displacement connector with a conventional solder-type connector. The ribbon will be firmly locked in place if you fold it on itself and wrap a heavy layer of tape where the wire passes through the connector's cable clamp.

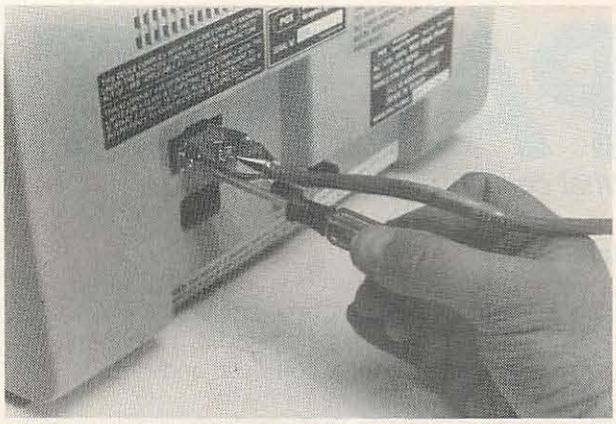


FIG. 10—THE WEIGHT of the relatively heavy shielded hoods commonly used on monitor cables often works them free after several months. Simply tightening the hood's locking screws (if you didn't use them—which is not unusual) is often the cure for an intermittent monitor.

no maintenance other than cleaning a daisy wheel print element that's used with a fabric rather than a "one time" (polyethylene) ribbon. About the only required maintenance is an infrequent cleaning of the rubber platen of a letter quality printer. Over a long period of time just normal grime can cause a hard film to accummulate on the rubber, which can interfere with the character impression. Most stationary stores sell platten cleaners, which are small pads containing a crush-tube that releases a premeasured quantity of alcohol into the pad when squeezed. A few passes of the pad over the platen and the hard coating is removed. (Fig. 11)

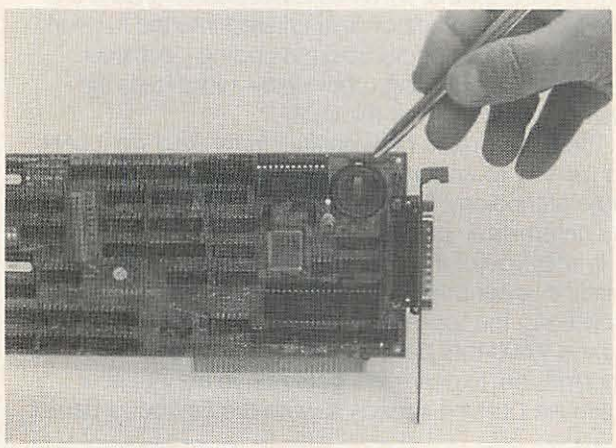


FIG. 11—ACCESSORY BOARDS powered by Mercury or Lithium batteries often develop intermittents not because the battery is dying but because it is leaking electrolyte: actually a microscopic film that gets between the battery and the socket's contact. Usually, a wipe with a cloth will restore operation, but the battery should be replaced immediately, before the electrolyte permanently damages some components.

In general, computer care is more common sense than anything else. If the system was installed properly, if all cables are secured and someone doesn't drop a jelly sandwich into the printer, it will probably keep going for years with the least amount of service and attention. Just remember the golden rule of personal computers: "If it ain't broke, don't fix it."◀Ⓓ▶

PACKET RADIO

What cellular did for the telephone...

Marc Stern

■One of the most exciting phenomena to hit Amateur Radio in the last 15 years is packet radio. It represents the marriage of the personal computer and communications technology.

The growing interest in packet radio is an outgrowth of the availability of small-computer systems as the Commodore VIC-20 or C-64; the desire to use the computer for communications, and the availability of interface software and hardware. It's a case of the right pieces being in place at the right time.

Over-the-air links

The result has been a rapidly spreading over-the-air computer network that is linking cities all over. When you think about this network, you begin to realize it has a great deal in common with packet-switched, local area networks (LAN). The difference is, that this network is linked via radio. (See Fig. 1)

Like a LAN, each outlet is called a node and special hardware is needed to enable the interface between the Amateur Radio station's computer, transceiver and the network.

In a LAN, special software is needed to enable the interface. Each piece of data entered into the network is preceded by special address coding—Amateur Radio callsigns, among other data—which tells the system where to send the data.

The packet radio network functions like a giant LAN. So it's easy to underestimate the importance of packet radio technology, but it represents an important step in the transmission of data.

It frees you of the constraints imposed by the wireline telephone system. Because of bandwidth limitations, the top speed that can be accommodated now is 9,600-bits per second (baud) of data transmission. Experiments going on in the Amateur realm are pushing speeds toward the 56K-baud barrier, or about a 600 percent increase in speed and a manifold increase in data density.

And this information is delivered free of errors thanks to the error-recovery nature of the packet radio network. Because of the unique packet data encoding, if the transceiver for which the information is destined doesn't receive the entire message or the checksum error-checking code is incorrect, the network will keep trying to get that information through until it receives an acknowledgement that it has been sent correctly, even if the error occurs mid-word or mid-sentence.

Finally, this system is secure and spectrum efficient. Because it depends on unique addressing, messages that aren't intended for your node go unread by your terminal program. You may see a record of activity on a frequency, but, unless a message is broadcast as a bulletin to many Amateur stations or nodes, you won't see its contents because the system will prevent it. Spectrum efficiency is ensured because it uses frequency modulation and digital packets.

One of the functions of FM radio is the capture effect. When a signal has captured or saturated the discrimator circuitry of an FM transceiver, that radio hears no other signal. With the distances involved between packet radio system nodes, it is unlikely that any transceiver will "capture" the system for more than a transmission or so and this will allow several stations to be on frequency at once, each using the system in turn. (Local stations working in packet, likewise, won't bother the overall network because they are unlikely to be transmitting with the amount of power needed to do it. Therefore, the overall network won't hear them and will continue to move data. Again, the capture effect is at work.)

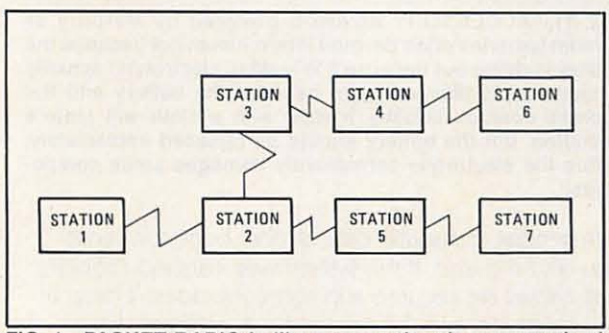


FIG. 1—PACKET RADIO is like an over-the-air computerized Local Area Network, each node communicating with only those it is seeking. Its attraction is high speed, secure communications.

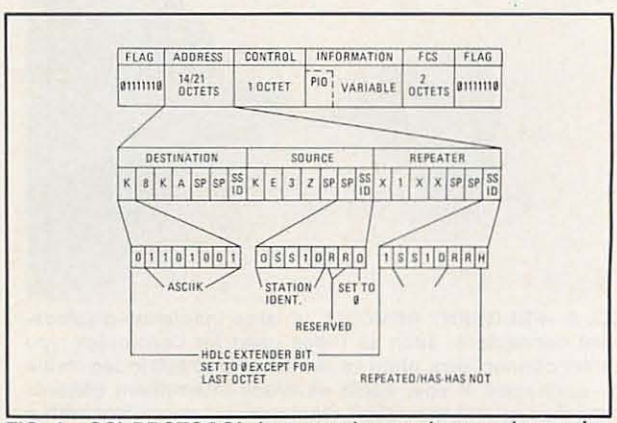


FIG. 2—OSI PROTOCOL is seven layers deep and was developed to promote compatible communications among devices. Solid lines are interfaces between layers, arrows indicate how like layers attract.

When two stations transmit simultaneously, part of the protocol which drives the packet network checks periodically to see if the network is busy or free. If it is busy, the node refrains from activity until it is free. When it is free, that station can slip its packets into the data stream and they will move along it until they arrive at their destination.

Seven layers

One of the plans which packet networks adopted early on was the Open Systems Interconnection (OSI) model on which to base network interaction. OSI, developed by the International Organization for Standardization (ISO), was developed to ensure compatibility between communications devices.

The OSI model specifies a seven-layer structure, each with its own protocol. Within each layer, the structure is modular, allowing differences in design and in the validation of protocols. (See Fig. 2.) Level 1 is the Physical layer which is concerned with bit-level data. The RS-232 and CCITT standards apply here. Hardware is impacted by this layer. Level 2 is the Link layer which arranges the bits into frames. At this level, the most common packet protocol is the ISO High-Level Data Link Control. This layer establishes a link (circuit) through supervisory frames and performs error checking and recovery. Level 3 is the Network layer which handles the addressing; routing; multiplexing, as well as flow control. At this layer, packet describes the message structure.

Level 3 can establish two types of network, virtual and datagram. The virtual circuit establishes a logical connection between the end points and then uses an abbreviated packet header. The datagram uses complete header information.

This layer can be further subdivided into internet or Sublayers A and B.

Level 4 is the Transport layer. It arranges the information in the correct order in the event that packets arrive out of order after traveling through a network. It also reassembles any packets scrambled as they move through the network.

Levels 5—Session layer, which handles log-on, logoff and authentification; 6—Presentation Level, which performs code conversion, control data structure and display formats and manages data interchange with peripheral storage devices, and 7 the Applications layer, which is user software and interface, handle various housekeeping and interface chores.

For our purposes, the important levels are 1, 2, 3, 4 and 7. They define the packet system.

Packet hardware, software

Although packeteers could have used the EIA RS-232 standard, they chose the CCITT V.24 and V.28, which specified the pinouts in the network connector. They also used the Bell 202, as opposed to the newer 212A modem standard, because there were some 202 models available on the surplus market. These modems use a 1200 Hz mark and 2200 Hz space.

Encoding in a packet radio system is predominantly a baseband technique. Called nonreturn to zero, inverted, a 0 causes a change in signal level at the beginning of a bit interval, while a 1 causes no change.

This type of encoding is supported by such controller chips as the Intel 8273; Zilog 8530, and Western Digital 1933. All of this is housed and implemented by a device which is called a terminal node controller (TNC). A combination modem-computer, the TNC and its protocol senses when a network is free; turns digital information into analog data so it can be sent across the network, and takes analog information and turns it into digital information so it can be used at a node.

The Amateur packet network uses a version of CCITT standard X.25 called A(mateur)X.25 and it defines how digital information is framed into a packet. The frame consists of the beginning flag, address field, control field, information field, frame-check segment and ending flag. (This data are sent with 16 inversions so it can be synchronized with the network.)

The flags are always represented by 01111110, while the address field consists of two or three specially encoded ham call signs, the destination, source and, optionally, the repeating stations used to get the information from A to B. The last octet of each address element is reserved for a secondary station identifier. The control field is used to identify a frame's type and also signals a connection request, ready-not ready conditions, frame numbers and modes of operation. As you'd expect, the information field is used to convey the message and the frame-check sequence is the checksum.

As these frames and others move through a radio packet system they head for their designation nodes. It is up to each node to assemble or disassemble the information. The TNC not only acts, therefore, as the modem, but also as a special-purpose microcomputer. Software to handle the assembly or disassembly is stored in Programmable Read-Only Memory. It implements the HDLC.

Importance of system

Such is the reliability and security of the Amateur packet system that commercial manufacturers and the military are studying it closely. Amateurs have proved that it is possible to use radio to enable a high-speed, dense information flow. It also opens some interesting commercial possibilities.

Imagine using an FM station's SCA for data communication. Or using a business band frequency for secure, high-speed, close-of-business data transmission. In minutes an entire day's transactions can be reliably sent from point A to B, securely and without error. It's an interesting concept, especially as Amateurs work for higher speed levels, such as 19.2K-baud and 56K-baud. Further, it provides a cost-effective alternative to satellite or terrestrial links. In fact, it looks so attractive that commercial providers are already bringing their own TNCs to market.

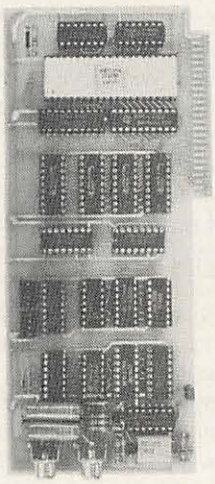
So, once again, the Amateur Radio community is at the cutting edge of communications technology, making the inevitable marriage of computers, radio and communications work and work well, too.◀CD▶

BUILD THE GRAFEX-32

PART 3

High-Resolution Graphics for your Apple II.

RAY DAHLBY



This article was begun two issues ago, continued in the last issue, and is concluded here. We'd recommend that you go back to the February, 1986 issue and re-read the entire story from beginning to end, and if you elect to build this unit, do so, knowing that you now have all of the required information.

A word about monitors

Before I set out to design this project, I went looking for a video monitor with two essential characteristics; a high video bandwidth and a long persistence phosphor screen. The Sanyo 9-inch B&W monitor I had been using with my Apple did a satisfactory job displaying the Apple's 40 column text and 280 by 192 graphics screens but blurred noticeably when displaying 80 column text, an indication of its rather poor video bandwidth of 5Mhz or so. In order to display 640 dots in a 40 μs line, the required video bandwidth should be about equal to the dot clock frequency of 16 Mhz. Another characteristic of the Sanyo, which is common to all video monitors using a standard short persistence phosphor screen, is a flicker effect when displaying interlaced computer graphics images. This flicker is the result of the non-spatially limited bandwidth nature of computer generated images as compared to images from a video camera. Since interlace is necessary to get a vertical resolution above about 200 lines and still stay within NTSC television timing, (and thus retain monitor-compatibility with the Apple II), I had to find a screen with a longer persistence. Fortuitously, Apple Computer Inc. came to my rescue when they introduced the Monitor III. This screen has the necessary combination of high bandwidth, long persistence, and modest price. I wondered if they anticipated my needs since the Apple II does not normally require these.

A peculiarity of the 7220 when generating interlaced video is a timing skew between sync pulses responsible for even and odd video fields. The effect on some monitors, is line-pairing which shows up as an uneven spacing between horizontal lines. This effect can be eliminated on the Monitor III as well as other monitors by a slight adjustment of the vertical hold control.

The Grafex sub-interpreter software includes a command to switch the display from 640 by 400 interlaced video to 640 by 200 non-interlaced. This command can be useful for those users who do not have a long persistence screen. The 400 line vertical resolution can still be used by programs to address to complete bit-map and the display scrolled vertically to view it. In effect, the screen shows a window of 640 by 200 on a 640 by 400 "world." If 64K by 4 bit RAM chips are substituted for the 16K by 4 bit 4416's, this "world" will be 640 by 1600. The sub-interpreter has a command called "SCROLL" which accepts a parameter in the range of 0 to 1599 for this purpose.

Conclusion

The 7220 is the first graphics co-processor chip to become widely available in the microcomputer marketplace. Now in volume production, it has dropped in price to about $40.00 in single units from over $100.00 a year ago. The Grafex board serves as an evaluation and development tool for this chip, in addition to its main use as a graphics expander for the Apple II. As more sophisticated graphics co-processors and larger memories become available, the open-architecture of the Apple II will likely play host to these products as well, allowing Apple users the opportunity to stay abreast of the latest technology while expanding and enhancing the utility of their machines.

It was not the intention of this article to provide a complete tutorial on programming the 7220. Such a tutorial alone would take several times the size of this article. A software package has been written to facilitate the use of the Grafex circuit board from BASIC programs. This package is in the form of a sub-interpreter to Applesoft and adds about thirty commands relating to drawing points, lines, rectangles, arcs and circles as well as text, from within Applesoft BASIC programs. Please check the end of this article for prices and ordering information. Those readers interested in writing their own drivers for the 7220 are urged to buy, borrow, or steal a copy of the "7220 DESIGN MANUAL." This 138 page book is an excellent source of information on both the hardware and software aspects of this chip. It is available for $10.00 from NEC Electronics U.S.A., One Natick Executive Park, Natick, Massachusetts 01760.

PARTS LIST
SEMICONDUCTORS
D1, D2—1N914 or 1N4148 diode
IC1—PD7220D graphic display controller
IC2, IC3—74LS00—Quad NAND gate
IC4—74LS02—Quad NOR gate
IC5—74LS86—Quad exclusive OR gate
IC6—74SO4—Hex inverting amplifier/buffer
IC7-IC9—74LS74—duel-D flip-flop
IC10, IC19—74LS174—Hex-D flip-flop IC11—74LS245—Octal transceiver
IC12—74LS374—Octal D-type flip-flop
IC13-IC16—TMS4416-20NL Dynamic RAM
IC17, IC18—74LS166 Paralle-to-serial shift register
IC20—74LS163PNP Binary Counter
Q1—2N3906 PNP Silicon Transistor
Q2—2N3904 NPN Silicon Transistor
XTAL—16MHz quartz crystal

CAPACITORS
C1-C5—0,1 + microF, 50-volt ceramic disc

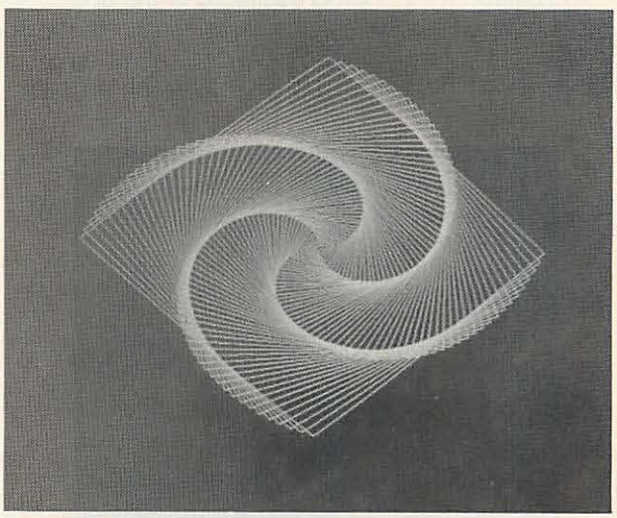
RESISTORS
(All rersistors ¼-watt 5%)
R1, R2, R9—100-ohm
R3, R10—1000-ohm
R4—1500-ohm
R5—3300-ohm
R6—2200-ohm
R7—5100-ohm
R8—200-ohm
R11—75-ohm

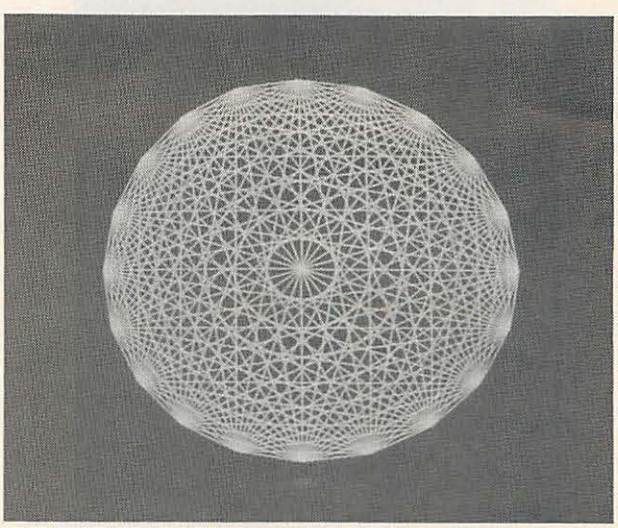
MISCELLANEOUS
J1, J2—PC-mount phono jac
RY1, RY2—SPST N.O. 5-volt reed relay

KITS AND SOFTWARE AVAILABILITY
The following kits and software packages are available for the Grafex-32: a) Printed circuit board (professionally made with plated-through holes, solder-mask and gold-plated edge connector) $45.00. b) Kit of all parts for above $125.00. c) Assembled and tested board $195.00. d) Sub-interpreter software and demos on 5¼" diskette, Apple DOS 3.3 $45.00. e) Color software package on 5¼" diskette. Apple DOS 3.3 (requires three Grafex-32 boards and RGB monitor) $95.00. Please add $4.00 per order for Air-mail postage and handling. Payment accepted by check or money order in U.S. funds to: Ray Dahlby Electronics, Dept. #255, Box C 34069, Seattle, Washington 98124-1069, or: Ray Dahlby Electronics, Dept. 255-810 West Broadway, Vancouver, B.C. V5Z 4C9, For technical inquiries, phone (604) 732-1080 (no phone orders please).

The screen photos

The screen photos reproduced here were taken from an Apple Monitor and show text and graphics at 640 by 400 resolution. The displays were generated with a Grafex board installed in an Apple IIe running under Applesoft Basic with the Grafex sub-interpreter software. The text displayed in these examples comes from a software character set loaded into system RAM by the sub-interpreter. All Grafex displays are bit-mapped; there is no hardware character generator on the board. The character font stored in system RAM can be read into the 7220 GDC which then writes it into the screen bit-map in any of eight directions and 16 sizes. In addition, derived character sets can be displayed by





THE AVAILABLE DETAIL at 640 by 400 resolution . These are common examples of computer graphics. Start with a figure, and repeat at different rotations and sizes.

shifting the position of characters and writing them on top of themselves using the set, clear, and complement modes of the GDC.

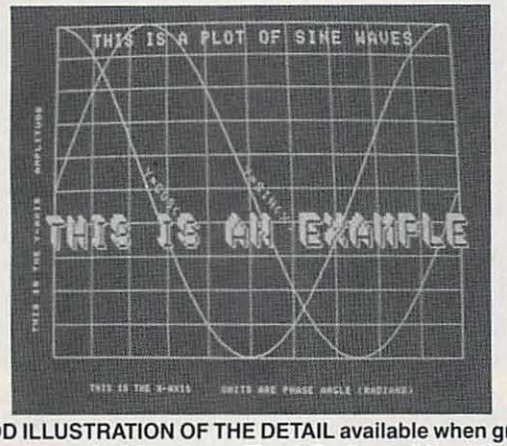
Photograph #2 shows a barberpole effect of 80 columns by 50 rows of text. The character set used in this and the other examples, is made from a 5 by 7 dot matrix in an 8 by 8 box.This character set includes the complete 128 character ASCII set. The Monitor /// screen displays highly readable text in this 80 by 50 format and, in fact, I find it to be preferable to the Apple 80 column display.

The 8 drawing directions are shown in photograph #3.The title for this display was produced by writing the string "DIFFERENT DIRECTIONS" at a magnification factor of 2, and then writing it again but with the x and y starting position shifted by 1 pixel and the mode set to complement.

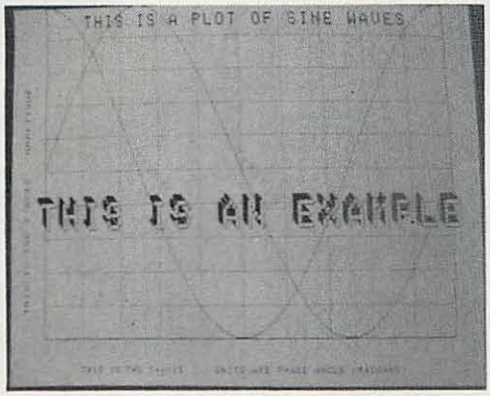
Photographs 4, 5 and 6 show off the detail available at 640 by 400 resolution and are quite common examples used in computer graphics. Photos 4 and 5, for example, are simply the result of repeatedly drawing a triangle and a rectangle, at different rotations and sizes.

Photograph #7 is a good illustration of the detail available when graphing mathematical functions. The 3-D effect of the titling is again produced by writing a shifted text string on top of itself. Photograph #8 is the same screen image complemented.The GDC can perform an exclusive-or of this type on 32K bytes of memory in under 16ms, obviating the need for hardware reverse video capability.

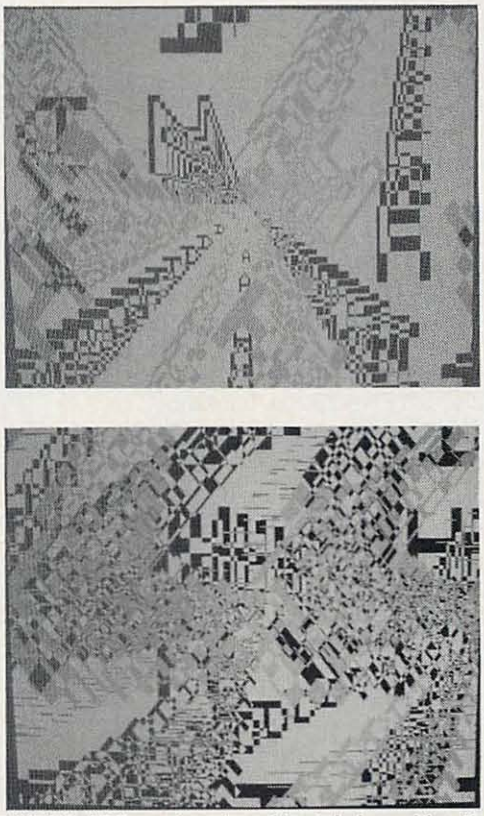
The last two pictures, #8 and #9, show a fancifull "video art" example I wrote by accident. This effect is produced by writing the letter "A" at different magnifications, rotations, and modes (set, clear, and complement). The program, written in Applesoft Basic, is just a few lines in length yet produces videotape-like animation.



GOOD ILLUSTRATION OF THE DETAIL available when graphing mathematical functions. The 3-D effect of the titling results from a text string written on top of itself.



THE SAME SCREEN IMAGE COMPLIMENTED. The GDC can perform an exclusive-OR of this type on 32K-bytes of memory in under 16 ms.



SOME VIDEO ART produced accidentaly by writing the letter "A" at different magnifications, rotations and modes. The program, written in Applesoft BASIC, is just a few lines in length yet produces a videotape-like animation.

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1—"High Resolution Sprite-Oriented Color Graphics:" Steve Ciarcia: Byte Magazine, August 1982.
2—"Polish Your Apple With A Luminance Board:" Ray Dahlby: Computers and Electronics magazine, November 1982.
Further Reading
1—"Display Controller Simplifies Design of Sophisticated Graphics Terminals:" Jeffery L. Wise and Henryk Szejnwald: Electronics magazine April 7, 1981.
2—"Super Graphics Hardware from NEC :"Steve Levine: Byte magazine, April, 1983.
3—"MOS Memory Data Book": Texas Instruments:1984.
4—"Output-enable feature a must on fast common I/O memories": Al Reddy and Sherri Craig: Computer Systems Equipment Design magazine, January, 1985.◀CD▶